

REMARKS/ARGUMENTS

Claims 1, 4-11 and 20 are pending in this application. Claims 2, 3 and 12 have been canceled, and claims 13-19 have been withdrawn. Claim 20 is new.

In the Final Rejection of March 30, 2007, claims 1, 2, 6 and 7 were rejected for anticipation by Ballantine (6,740,437), and claims 3-5 and 9-11 were rejected for obviousness over Ballantine in view of Haltiner (6,967,064).

In accordance with the present invention, anode gas from the anode side 4 of the fuel cell 8 flows through inlet 10 into heat exchanger 14. In a mixing space 26 downstream of the heat exchanger, the anode gas is mixed with air and the resulting mixture is fed to catalytic reactor 28, where the combustible components of the anode gas are oxidized, thereby heating the air-anode gas mixture. From the catalytic converter, the anode gas-air mixture flows through return conduit 32 to the fuel cell. Paragraph [0019].

The anode gas normally exits the fuel cell at a high temperature of about 1200°F-1300°F. "Such high temperature anode gas if mixed immediately with the air can form pockets in the mixture that can lead to the earlier mentioned, undesirable auto-ignition of portions of the mixture." Paragraph [0011]. To prevent such auto-ignition, the anode gas is passed through heat exchanger 14, where some of its heat is used for heating the combustion air, which is thereafter "mixed with the anode gas so that the peak temperature in the mixing zone [26] is below the auto-ignition temperature of the fuel components" Paragraph [0009]. The anode gas temperature is thereby correspondingly reduced.

Claim 1 has been amended and now recites amongst others "transferring heat from the anode gas to the air before the air is added to the anode gas to thereby lower a temperature of the anode gas"

Independent claim 9 has always been directed to this feature and has been slightly reworded so that it now requires "transferring heat from the anode gas to the air flow in the first and second flow paths to thereby decrease a temperature of the anode gas and form a cooled

anode gas, thereafter mixing the cooled anode gas and the air flow downstream of the flow paths to form a mixture”

The prior art does not transfer heat from the anode gas to combustion air. The prior art also does not thereafter mix the two so that heat can be generated with the combustible components in the anode gas-air mixture by oxidizing them to raise the temperature of the mixture. Paragraph [0025].

The Final Rejection acknowledged that Ballantine does not teach exchanging heat between the air flow and the anode gas prior to combining them. However, Haltiner was viewed as teaching transferring heat from the reformat “which is the anode gas” and the air flow in a heat exchanger 124.

The “reformat” in Haltiner is not the anode gas.

In Haltiner, “unconsumed fuel 110” (column 4, line 54) from the anode is fed to an afterburner 66 which emits a hot burner gas 112 that is directed through a clean-up catalyst 114 and heat exchangers 94, 92. The partially cooled effluent 115 from heat exchanger 92 is then fed to “manifold 120 surrounding stacks 44, 46 from whence it is eventually exhausted 122”. (Column 4, lines 61-63).

Haltiner feeds cathode air 75 and reformat 108 to the fuel cell without first mixing them. The reformat fed to the fuel cell is not the unconsumed fuel 110 from the anode side of the fuel cell, but fuel from storage tank 96 that is fed via fuel pump 94 to vaporizer 76, where the fuel is vaporized. The vaporized fuel is fed to reformer catalyst 104 in main fuel reformer 106 which reforms the fuel to principally hydrogen and carbon monoxide. From there, the resulting (fuel) reformat is directed via heat exchanger 124 to the fuel cell. (Column 4, lines 49-53).

Haltiner does not disclose or suggest “transferring heat from the anode gas [recovered from the fuel cell] to the air before the air is added to the anode gas to thereby lower a temperature of the anode gas” as required by amended claim 1.

Haltiner also does not disclose or suggest “adding air to the anode gas to form an oxidizable anode gas mixture”, as also required by claim 1.

The same applies to independent claim 9. Haltiner neither discloses or suggests “transferring heat from the anode gas to the air flow in the first and second flow paths to thereby decrease a temperature of the anode gas and form a cooled anode gas” nor does Haltiner disclose or suggest “thereafter mixing the cooled anode gas and the air flow downstream of the flow paths to form a mixture”.

Since neither Ballantine nor Haltiner disclose or suggest cooling the anode gas by transferring heat from it to the air so that potential auto-ignition problems do not occur, and further because neither of the two references discloses or suggests to mix the anode gas and the air before directing them as a mixture via a catalyzer to the fuel cell, independent claims 1 and 9 are not obvious.

The remaining dependent claims 4-8, 10 and 11 are directed to specific features of the present invention which are patentable in their own right.

For example, claims 4, 5 and 10 were rejected for obviousness because Haltiner was viewed as teaching to exchange heat between the reformat [which is considered to be the anode gas, which, in fact, it is not, as was discussed above] and the air flow in a co-flow heat exchanger 124 defined by sinusoidal tube 138 for conveying the reformat and a chamber which air passes through. Final Rejection, page 5.

For the reasons discussed above, the reformat of Haltiner is not an anode gas.

Thus, Haltiner does not and, indeed, cannot teach or suggest first and second flow paths for the anode gas and the air flow, separated by a heat exchange medium, to transfer heat from the anode gas to the air and selecting the lengths of the flow paths so that substantially no portions of the mixture are above the auto-ignition temperature of the combustible components in the anode gas as required by claims 4, 5 and 10.

In view thereof, claims 4, 5 and 10 are patentable because they are not obvious over Ballantine and/or Haltiner. These claims are further allowable because they depend from allowable parent claims.

New independent claim 20 is similar to claim 1 and differs therefrom primarily in that it recites exchanging heat between the air and the anode gas prior to forming the mixture to lower “local peak temperatures” that might develop during forming the mixture to avoid the above-discussed auto-ignition temperature problem. In this regard, Paragraph [0011] discloses that the “air [that is being mixed with the anode gas] can form pockets in the mixture that can lead to the earlier mentioned, undesirable auto-ignition of portions of the mixture”. New claim 20 is more specific relative to claim 1 in that it recites that heat is exchanged “to thereby lower local peak temperatures” that can develop during operation, the term “local peak” referring to the pockets described in the specification.

All arguments set forth above why claim 1 is not obvious over Ballantine in view of Haltiner equally apply to claim 20. Claim 20 is therefore also not obvious over these references.

CONCLUSION

In view of the foregoing, applicant submits that claims 1, 4-11 and 20 are allowable and requests a corresponding notification at an early date.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at (415) 273-4730 (direct dial).

Respectfully submitted,



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